



Strategies for Achieving Profound Pulpal Anesthesia in the Mandible

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Introduction

Studies on inferior alveolar nerve blocks (IANB) suggest that it is only 19% to 56% effective in achieving profound pulpal anesthesia in teeth with irreversible pulpitis (1). This may be explained by mandibular nerve anatomy and physiology. Nerves in the periphery of the mandibular bundle supply molar teeth while those closer to the core innervate incisors (2). Anesthetic solution is unable to diffuse into the nerve trunk in concentrations high enough to completely block impulses, resulting in higher anesthetic failure rates for mandibular anterior teeth (2-4). Neurons associated with inflamed tissue have altered resting potentials and decreased excitability thresholds (5). Tetrodotoxin-resistant sodium channels have increased expression in irreversibly inflamed pulp and are less sensitive to local anesthetics (6). Pre-existing pain and apprehension, the patient's response to pain and the dentist's approach may also lower pain thresholds (7,8).

The Gow-Gates (GG) and Vazirani-Akinosi (VA) injections are touted as superior to the IANB, while comparative studies find no difference (4,9). Combining injections which target different sites along the mandibular nerve (e.g., an IANB with a GG or VA) may result in more profound anesthesia (9,10). Currently, there is no data to confirm this.

The type of anesthetic used does not significantly affect the outcome. Solutions of 4% articaine are found to be no more effective than 2% lidocaine (1:100,000 epi) (11,12). Likewise, 3% mepivacaine and 4% prilocaine solutions are found to be as effective as 2% lidocaine with epinephrine for 55 minutes of pulpal anesthesia (13,14). Also, no significant difference is found between using one versus two cartridges of 2% lidocaine (1:100,000 epi) (4,15).

Lip numbness occurs within 5-9 minutes of injection. Pulpal anesthesia in mandibular teeth takes 15-16 minutes, or longer, 19-27% of the time (13,14). Administering an IANB over 60 seconds results in a higher anesthetic success rate and patients report less pain than if the injection is given over 15 seconds (16). Confirming pulpal anesthesia with a negative response to cold or an electric pulp test (EPT) is more reliable than lip numbness (4,17,18). If a slowly delivered block and adequate time fail to produce pulpal anesthesia, the following **supplemental injections** should be considered.

Infiltration

Buccal infiltrations of 2% lidocaine (1:100,000 epi) or 4% articaine (1:100,000 epi) after IANB significantly increase anesthetic success in mandibular first molars from 59% to 71% and 88%, respectively (19). However, a study of patients with irreversible pulpitis reports supplemental buccal infiltrations of articaine are 58% successful (20). Combining labial and lingual infiltrations of lidocaine is more effective in attaining pulpal anesthesia in the anterior mandible than either a labial or lingual injection used alone (21,22).

Incisive Nerve Block

An incisive nerve block is excellent for anesthetizing premolars and when used in combination with an IANB, increases the success of first molar anesthesia to 70% (23). It has limited use for anesthetizing mandibular incisors (23). As a primary technique, it is up to 94% successful only if the block is delivered with the needle positioned to enter the foramen (24).

Intraosseous

Intraosseous (IO) injections deliver local anesthetic solution directly into the cancellous bone adjacent to the tooth to be anesthetized. Use of the Stabident® (Fairfax Dental Inc., Miami, FL) or X-tip® (DENTSPLY Maillefer, Tulsa, OK) intraosseous system produces high rates of profound anesthesia. The onset is nearly immediate (25) and the duration, 90% for 60 minutes (26) and 95% for 20 minutes (27) in first molars, compares favorably with standard nerve blocks. In a study of posterior teeth with irreversible pulpitis, supplemental mandibular IO injections are 90% successful in obtaining complete pulpal anesthesia (28). Reisman et al., reports that supplemental IO injections with 3% mepivacaine increases successful anesthesia from 25% for IANB alone to 80% in mandibular teeth with irreversible pulpitis. A second cartridge of 3% mepivacaine increases this success rate to 98% (29). There are side effects associated with IO injections. Patients may develop swelling or exudate at the site of perforation, likely due to overheating the bone (30). Other patients (5%-15%) report their tooth "feels high" to mastication for a few days (26,30). And 67% of patients experience an increase in heart rate of 12-32 bpm when epinephrine-containing local anesthetics are given IO (31). Although a transient increase in heart rate is not likely to be clinically significant in healthy patients, use of a 3% mepivacaine solution without a vasoconstrictor is advised for patients with heart problems (31).

Intraligamentary

Another type of IO anesthesia (32), intraligamentary (IL) injections, can be highly effective. In a study of patients with irreversible pulpitis, this injection type is 74% successful on first attempt, and 95% successful on a second attempt (33). The duration of anesthesia is shorter than other IO injections due to the low volume of anesthetic delivered. Though no long-term deleterious effects on the pulp are observed (34), 36% to 49% of patients report soreness after IL injections (35). Computer-Controlled Local Anesthetic Delivery (C-CLAD™) systems, The Wand/Compudent® and STA (Single Tooth Anesthesia) System® (Milestone Scientific Inc, Livingston, NJ), are useful in delivering IL anesthesia (36,37).

Intrapulpal

In a small percentage of mandibular posterior teeth with irreversible pulpitis, supplemental injections fail to produce profound anesthesia (4). This is an indication for an intrapulpal (IP) injection. Depositing anesthetic passively into the chamber is ineffective. The anesthetic will not diffuse throughout the pulp. The type of anesthetic is unimportant. Strong back pressure is responsible for producing

anesthesia and similar results can be achieved using sterile saline versus a local anesthetic solution (38,39). Administered properly, an IP injection produces immediate, profound, pulpal anesthesia for 15-20 minutes (38,39). Special syringes or needles are not required, but it can be very painful and is recommended only as a last resort.

Conclusion

Attaining profound pulpal anesthesia in mandibular posterior teeth is likely the most difficult dental anesthesia challenge. Although 100% local anesthetic success is currently unachievable, there is excellent clinical evidence that with proper knowledge, technical skill and a systematic approach, profound anesthesia may be attained in up to 98% of patients.

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